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OBSERVATION OF THE CREATION OF MESON PAIRS

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In investigating the tracks of mesons in thick-layered photoemulsions exposed to cosmic rays at 6,000 meters, we observed two tracks with a peculiar distribution of the grains along the length of the tracks. Graphs describing the number n of grains versus distance s along the track showed a concave-upward curve with a minimum, instead of a simple monotonically decreasing curve. Both tracks were obviously due to mesons; we were convinced of this by the number of grains per unit length and by the characteristic bends in the trajectory due to manifold scattering.

In both the first and second tracks the number of grains per unit length regularly decreased from one end to the other. That is, this number diminishes from both ends toward the middle.

The first track, the general length of which was 1,274 microns, was broken down for ease of counting into 26 portions of 49 microns each. In each of these portions we summed up the number n of grains, which number we placed on the x-axis. From the curve obtained it is obvious that the number of grains per unit length decreased from an initial point A near the y-axis to a midpoint C, the minimum, and then the number n increased up to the end B of the curve. But at this end point B the number of grains was less than that at the initial point A, inasmuch as this end point B terminated in the air, whereas the initial point A was inside the emulsion.

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A similar graph was made for the second track also, which showed the same type of minimum at C. In this second case, however, both ends of the curve extended to the surface of the emulsion. The average length of this second track was 1,225 microns; that is, practically the same as the first one.

It is obvious in both cases that from the point C, namely the minimum point of the n-versus-s curve, there came pairs of mesons proceeding in opposite directions. The absence of a noticeable angle between the tracks indicated that during the creation of meson pairs a noticeable directional momentum was not imparted to them.

Since no third particle proceeding toward the point C was apparent and every charged particle of small momentum would certainly be observed, then there remained only one assumption, namely, that both of these cases were connected with a neutral particle. Such a neutral particle could be a quantum, neutral meson, or a very heavy neutral particle. However, a quantum producing a pair of mesons should possess, as it is easily calculated, a momentum ten times greater than the momentum of each of the mesons obtained, which obviously could not be possible.

Further, if these meson pairs were ejected from the nucleus of any neutral particle, say neutron, then the kinetic energy expended in fission would cause both mesons to have a direction close to the direction of the colliding particle.

If we exclude the above-mentioned possibilities, then it remains for us to assume that a meson pair (obviously positive and negative) must be created from the mass of a neutral particle, whose speed at the moment of disintegration is practically zero. Let us assume that in both cases we have to do with the creation of ordinary mesons of mass m equal to 200 electron-masses. Then, taking into consideration the small kinetic energy E of each meson, 4.0 Mev, we can find the mass M of the neutral meson to be approximately 416 electron-masses m_e.

In our case we have apparently witnessed the creation of a pair of positive and negative mesons originating from the mass of a neutral meson.

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